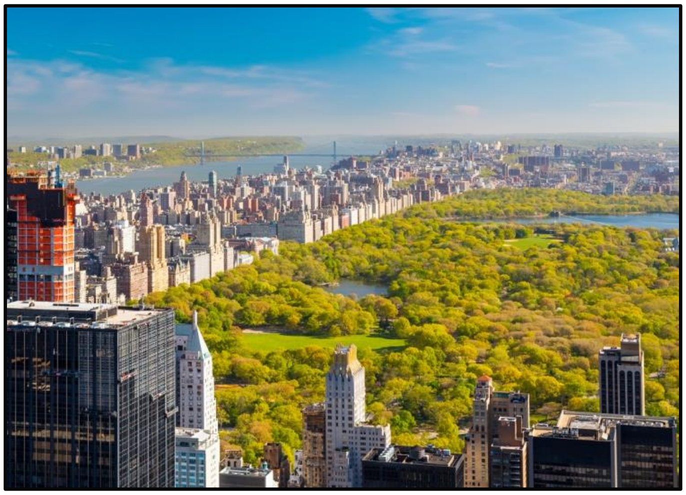
Value of Carbon Stored by Tree Cover

This EnviroAtlas community map estimates the value ($) of the total metric tons (mt) of carbon stored in the above-ground biomass of trees within each block group.



Why is carbon storage important?

Carbon is one of the most abundant elements on earth that forms the basic building blocks of most living organisms. Trees are capable of storing atmospheric carbon as biomass. Carbon typically comprises half of the dry weight of tree biomass. The carbon that is removed from the atmosphere by trees contributes to a more stable climate. This storage can be unpredictable and temporary, however, because the loss of existing trees releases this carbon back into the atmosphere.

Carbon comes in many forms, though carbon in the form of carbon dioxide (CO_2) is the dominant greenhouse gas (GHG) released into the atmosphere as a result of human activities. [1] The atmospheric concentration of CO_2 has increased by almost 40% since the start of the industrial revolution in the middle of the 18th century.[2] Increasing levels of atmospheric CO_2 and other greenhouse gases (e.g., methane, chlorofluorocarbons, and nitrous oxides) are thought to significantly contribute to an increase in atmospheric temperatures by trapping certain wavelengths of heat in the earth's atmosphere. Though several gases contribute to the greenhouse effect, CO_2 is estimated to be responsible for 80% of the current increases in climate forcing due to all GHGs since 1990.[3]

Climate change refers to any significant change in measures of climate (e.g., temperature, precipitation) that occurs over an extended period (e.g., decades).[1] This change can be from natural factors, human activities, or a combination of the two. In recent history, the increase of GHGs such as CO_2 has played a major role in recent warming trends and observed changes in climate.[1] The most recent decade was the hottest in recorded U.S. history and extreme weather events, such as heat waves and floods, have increased in frequency and intensity.[4] The U.S. has also experienced wildfires, droughts, increases in surface-water temperatures, more frost-free days and heavy downpours, more frequent and intense winter storms, and sea level rise; these changes can directly and indirectly affect human health in a number of ways.[4]

Trees are composed largely of carbon and continue to take in carbon as they grow. By fixing carbon during photosynthesis and storing it as biomass, growing trees act as a sink for CO_2. However, the loss of existing trees due to disturbances such as land use change, logging, and fires can release this carbon back into the atmosphere, consequently increasing levels of atmospheric carbon. Managing to maximize the tree storage of carbon and better control the disturbance of trees and forests can help maintain a more stable climate. This map uses the "social cost of carbon" as an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year.[5]

How can I use this information?

The map, Value of Carbon Stored by Tree Cover, can help users identify areas where most of the carbon is currently stored in trees within cities and the dollar value associated with that storage. Block groups with the most carbon stored (that has accumulated over many years) indicate areas where substantial amounts of carbon could potentially be lost back to the atmosphere should the trees be removed. The carbon values are directly related to tree cover based on average

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storage values per unit of tree cover. The dollar values estimate the societal value of the carbon storage. This layer can be combined with other community ecosystem service layers in EnviroAtlas to calculate the magnitude of multiple ecosystem services contributed by trees within a given area.

How were the data for this map created?

Data for this map were derived from a high-resolution land cover map developed by EPA. Within each block group area derived from U.S. Census data, the total amount of tree cover (m^2) was determined using this remotely-sensed land cover data. The USDA Forest Service i-Tree model was used to estimate the amount of carbon stored; the amount of tree cover was multiplied by the average carbon storage ratio for urban areas: 7.69 kgC/m^2 of tree cover.[7] National and state values are based on field data collected and analyzed in several cities by the Forest Service, with state values adjusted for the length of the growing season. These values were converted to total metric tons of carbon stored by census block group.

To estimate the monetary value associated with urban tree carbon storage and sequestration, carbon values were multiplied by $78.5 per ton of carbon (range = $17.2–$128.7 tC^{-1}) based on the estimated social costs of carbon for 2010 with a 3% discount rate.[6] To assess for the year 2016, users can multiply listed values by 1.87.

What are the limitations of these data?

All of the EnviroAtlas community maps that are based on land cover use remotely-sensed data. Remotely-sensed data in EnviroAtlas have been derived from imagery and have not been verified. These data are estimates that are inherently imperfect. The main limitations of these data derive from the fact that no field measurements were collected in the area. Carbon storage rates will vary locally based on tree diameter distribution, tree density, tree health, and to a lesser extent, species composition. These local variations will affect carbon storage estimates, but the average effects per unit of tree cover provide a first-order estimate of carbon storage. The block group summary assumes that tree cover is accurately portrayed on the land cover map. Estimates of below-ground carbon storage are not included.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. To find the EnviroAtlas 1-meter land cover grids created for each community, enter *land cover community* in the interactive map search box.

Where can I get more information?

There are numerous resources on climate change and carbon storage by trees; a selection of these resources is listed below. To learn more about i-Tree tools and how they can be used to support research, planning, and policy efforts, visit the i-Tree website. For more information on how the removal of air pollutants may positively affect human health, visit the Clean Air section of the Eco-Health Relationship Browser. For additional information on the data creation process, access the metadata found in the layer list drop-down menu for map layers in the EnviroAtlas interactive map. To ask specific questions about these data, please contact the EnviroAtlas Team.

Acknowledgments

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Selected Publications

1. IPCC (Intergovernmental Panel on Climate Change). 2013. Climate change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (Eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

2. National Research Council of the National Academies. 2012. Climate change: Evidence, impacts, and choices. Accessed October 2020.

3. National Oceanic and Atmospheric Administration. 2012. The NOAA annual greenhouse gas index. Accessed October 2020.

4. National Climate Assessment Development Advisory Committee. 2014. Climate change impacts in the United States: U.S. national climate assessment. Accessed October 2020.

5. Nowak, D.J., E.J. Greenfield, R.E. Hoehn, and E. LaPoint. 2013. Carbon storage and sequestration by trees in urban and community areas of the United States. *Environmental Pollution* 178: 229–236.

Nowak, D.J. 1993. Atmospheric carbon reduction by urban trees. *Journal of Environmental Management* 37(3): 207–217.

Nowak, D.J., and D.E. Crane. 2002. Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution* 116(3):381–389.